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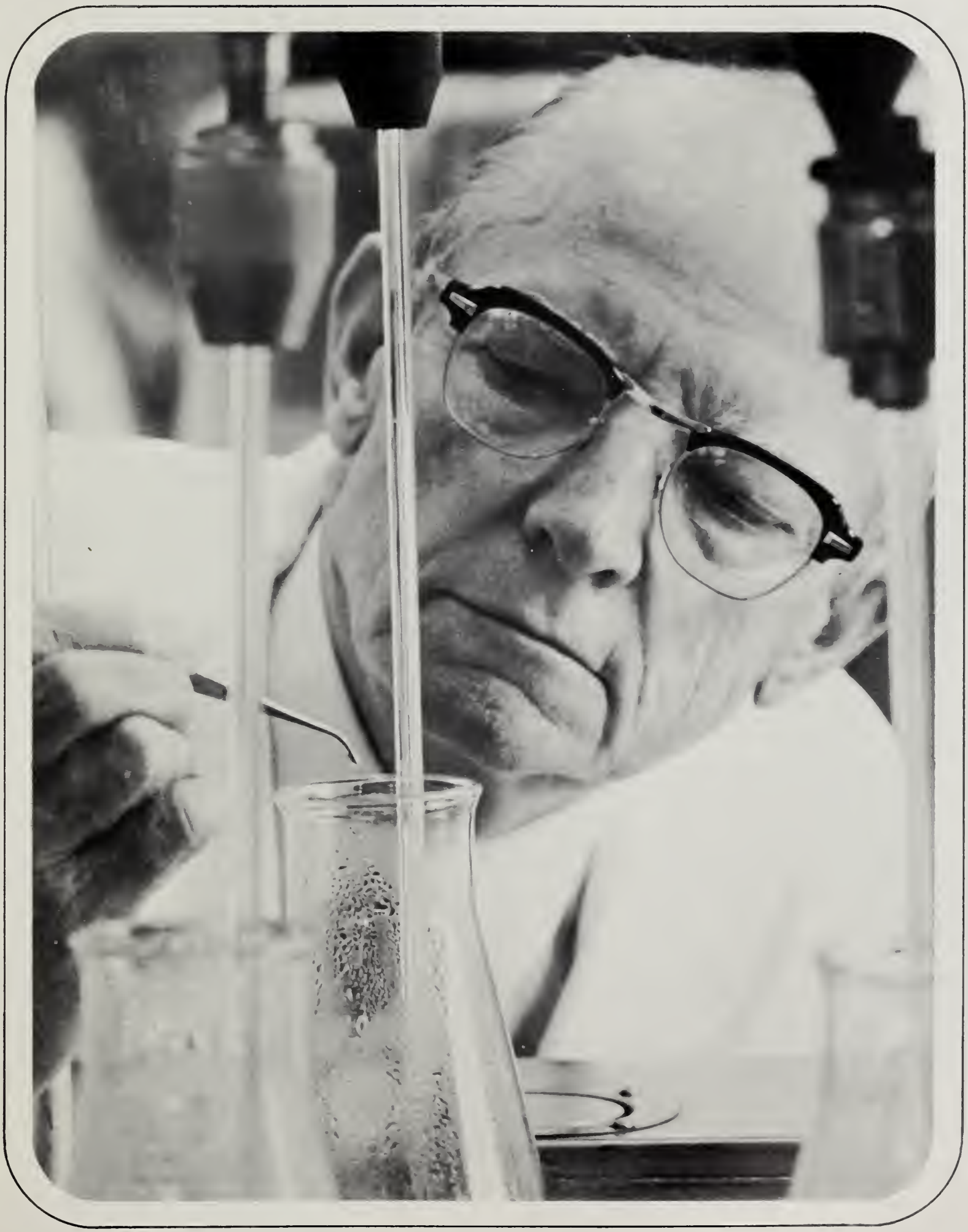

AGRICULTURAL Research

September 1971/Vol. 20, No. 3

Waste Not, Want Not

The old maxim "waste not, want not" rings a 19th century echo in today's affluent society, but its essential truth will grow in importance in the years ahead.

Everywhere thoughtful people are concerned about the ever accelerating consumption of our planet's natural resources. To complicate the problem, man's exploitation of natural resources typically leaves environmental degradation in its wake with the discharge of industrial, municipal, and agricultural wastes into the seemingly bottomless garbage cans provided by air, soil, and water. But the earth's natural resources are finite, both in their quantity and in their resiliency for degrading wastes. We must learn to recover, recycle, and reuse our resources.

Many of today's pollutants can be tomorrow's products. What such an immense reclamation task calls for is inventiveness, dedication, and money. Ideally, processors and manufacturers should not merely treat discharged effluents—they should find uses for all wastes produced in the plant. When this goal is not feasible, the plant should strive toward reclaiming and reducing as much waste as possible.

Agriculture has long experience in reclaiming plant and animal wastes and, more recently, those produced by the food processing industry. Important progress had been made, for example, in finding new uses for whey, a byproduct of cheese-making. Whey is a particularly potent polluter because of its high biological oxygen demand (BOD) when discharged into streams. Before World War II ARS scientists pioneered research on making such whey-based food products as candy and baked goods. Together with colleagues in industry they have since helped find uses in foods, feeds, and pharmaceuticals for over one-third of the 22 billion pounds of whey produced annually. Now, in current research they are subjecting whey to ultra filtration to obtain high lactose and high protein concentrates. The high protein concentrate would be especially valuable for fortifying cereals, citrus juices, and soft drinks.

The same approach can be addressed to other pollutants. For example, ARS scientists are working on methods for recovering proteins, amino acids, and other substances from the effluent of potato starch plants, a "scavenger" industry that relies on cull potatoes and scraps for its raw materials. Cull potatoes would be even more of a pollution problem if not used for starch. Hopefully, this and other research underway will add to the growing list of wastes turned into products. Research can help us use our resources more efficiently while improving the quality of our environment.

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COVER: In trichina larvae survival test, ARS parasitologist John S. Andrews places trichina-infested rat flesh into a solution that simulates digestion (page 3). He is trying to increase the solution's temperature—thereby reducing digestive time—and still maintain a 100-percent larvae survival rate. The best temperature and time will become standards for field detection tests (671X799–21).

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New techniques for

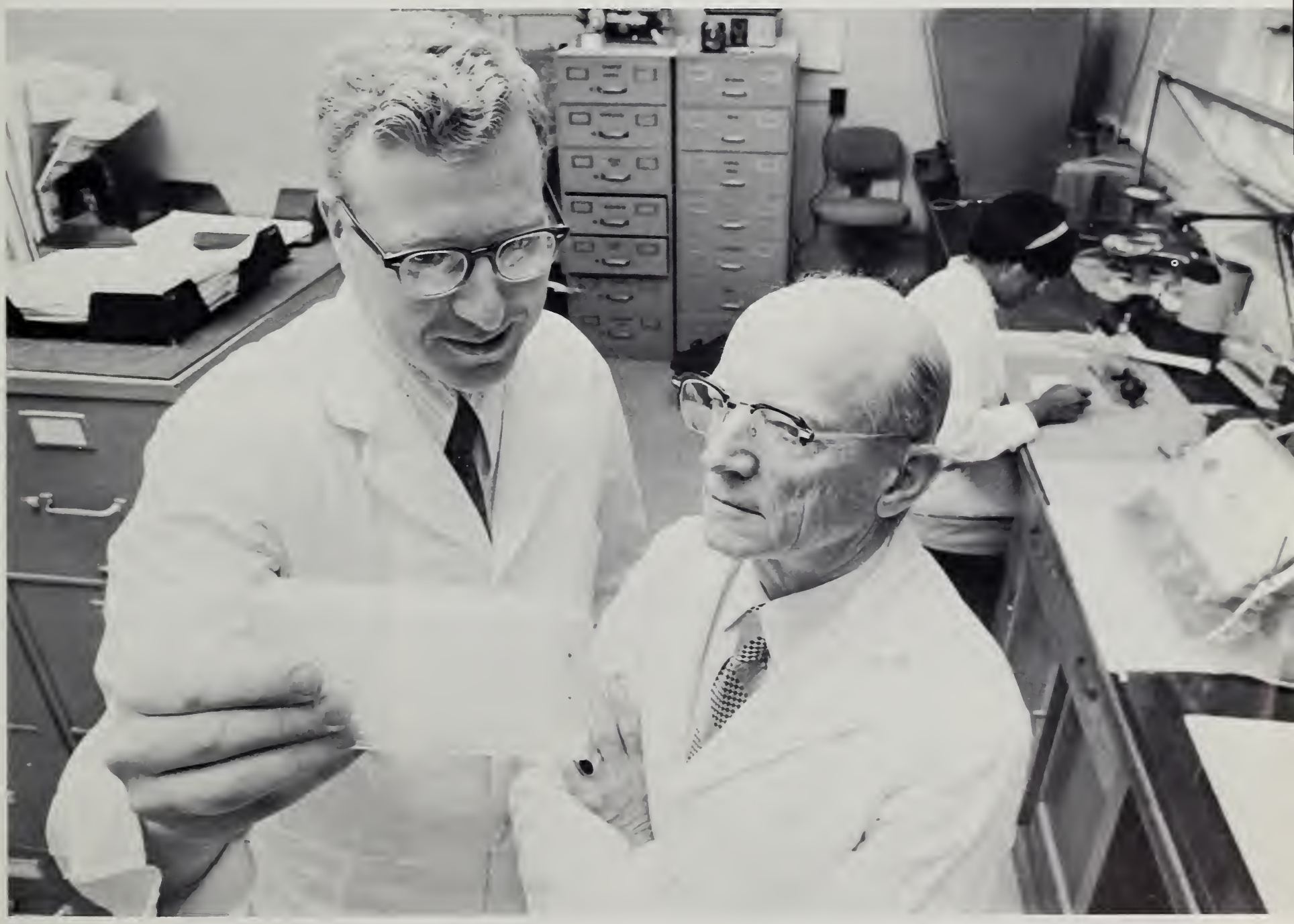
FASTER PORK TESTING

ERADICATION of trichinosis, a parasitic disease of hogs, may be a step closer with recently evaluated testing methods.

ARS parasitologist John S. Andrews, Beltsville, Md., participated in the first practical test of a pooled sample digestive technique in a commercial packinghouse. Developed by William J. Zimmermann of Iowa State University, Ames, the pooled digestive method is faster, more economical, and more sensitive than the trichinoscope method currently used in some countries.

The pooled sample technique works this way: Right after slaughter, hog carcasses are divided into lots of 20 to 25, with each carcass identified by lot. A 5-gram sample of diaphragm muscle from each carcass is removed, and those from each lot are ground together, digested in a pepsin-hydrochloric acid solution for 10 hours, and examined microscopically for trichina larvae. If trichinae are detected in the pooled sample, carcasses are tested individually. The entire testing process takes about 13 hours.

The new technique is compatible with high-speed slaughtering—testing was



Dr. Isenstein and Dr. Andrews examine disks on which antibody-antigen reactions occur in trichina detection technique called the soluble antigen fluorescent-antibody test (0671X800–9).

adjusted to a slaughter rate of 3,680 hogs per 8-hour day without disturbing the work flow. This amounted to 184 lots of 20 hogs daily. Since carcasses are normally held in a cooler for 24 hours after slaughter, testing doesn't delay normal operations.

Cost of the test came to about 10 cents per head, or 0.067 cents a pound of dressed pork—about 20 percent of the trichinoscopic method. Reliability was also excellent; infections as small as five trichinae per 100 grams of sample were detected in about 97 percent of the trials.

Samples from the same carcass were tested with both methods. Sensitivity was greater for the pooled sample technique. In one test, for example, 641.7 trichinae per gram were detected by pooled method but only 69 with the trichinoscope. In a series of low-level infection tests, the pooled method could detect from 0.01 to 5.6 trichinae per gram, while no trichinae in this range were detected with the trichinoscope.

While trichinae were introduced into some samples for test evaluation purposes, remarkably few were found in the hogs examined. During the 32-week testing period, 482,392 hogs were inspected, but only 42—0.00008 of 1 percent—were trichinous.

This project was carried out in cooperation with USDA's Consumer and Marketing Service, and pork and allied industry groups.

Another testing method, potentially even faster and cheaper than the pooled sample digestion method, looks promising in laboratory evaluations by ARS parasitologist Robert S. Isenstein, Beltsville.

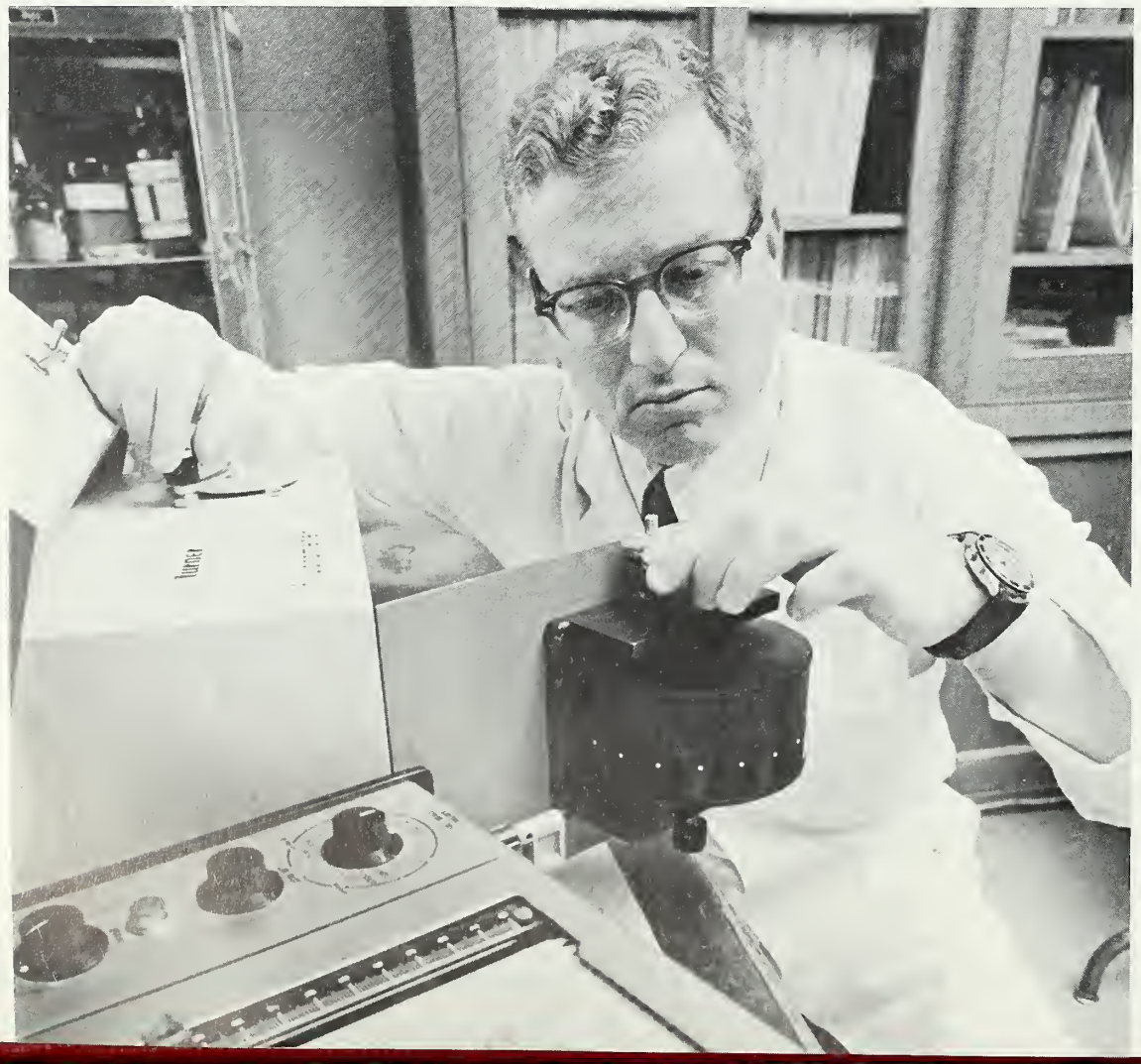
Called the soluble antigen fluorescent-antibody test by its developers, this new method has the potential advantage of being easily integrated into the plant's existing routine and automated.

With this method, a blood sample, possibly containing trichina antibodies, is placed on a disk previously saturated with trichina antigen. If antibodies are present in the serum, indicating infection, the disk will fluoresce when it is combined with blood fraction of anti-swine serum (so-called because it is taken from rabbits with antibodies to swine serum) linked to a fluorescent dye. Intensity of the fluorescence can be measured with electronic equipment, which simplifies interpretation.

The fluorescent antibody test can be performed relatively quickly, does not require elaborate equipment, and is applied to individual animals, making it more direct than pooled sample digestion.

While trichinae detection with this method must be evaluated in a packing-house situation, Dr. Isenstein finds the results from laboratory tests encouraging so far. □

Left: *In the soluble antigen fluorescent-antibody test, Dr. Isenstein unloads fluorometer after taking readings of fluorescing disks. Intensity of fluorescence, translated into peaks on the graph in foreground, indicates the presence or absence of trichinae (0671X800–21).* ***Right:*** *Laboratory aide Eleanor Moore performs the test on disks in spot plates (0671X800–28).*



CURING CONCRETE BY EMULSION

A ROUTE to expanding markets for linseed oil crosses a Wichita bridge finished in a January snowstorm.

Pawnee Avenue bridge over Gypsum Creek is the first where ARS-developed linseed oil emulsion was specified for curing concrete. It withstood 4½ winters of freezing and thawing under deicing salt before it received antispalling treatment in 1970.

Concrete curing is designed to limit rate of drying. Slower drying theoretically makes stronger concrete. Older curing methods include covering wet concrete with waxes or resins, plastic sheets, or wet burlap that must be kept wet. Some of these materials can blow off, dry out, or freeze. Some must be removed. None protects cured concrete against winter spalling, the surface cracking and scaling that occurs when water penetrates the concrete, freezes, and thaws. Salt accelerates spalling. The usual antispalling treatment for concrete cured by the old methods is linseed oil diluted with a flammable solvent applied about a month after the curing materials.

Wichita is the first city and Oklahoma the first State where emulsion curing is required by construction specifications. Engineers at both locations do not apply an antispalling agent for 2 years after emulsion curing. They agree that emulsion curing works under extreme weather conditions and saves labor.

The market for curing and antispalling agents is estimated at more than 50 million pounds a year, about one-sixth the current U.S. linseed oil production. This market is expanding as more concrete is used in buildings, roads, bridges, and other construction.

...Effective, labor-saving method now specified in Wichita and Oklahoma

Designed to compete in this expanding market, the oil-in-water emulsion was developed by chemist William L. Kubie at the ARS Northern marketing and nutrition research laboratory, Peoria, Ill., in research to find more outlets for the traditional paint oil.

Studies in the laboratory, on sidewalks in Peoria and Washington, D.C., and on bridge patches in Colorado City, Tex., indicate that the emulsion sprayed on wet concrete acts first as a curing agent and then as an antispalling agent.

In 1968, the Oklahoma highway department began testing emulsion curing in cooperation with ARS and the U.S. Department of Transportation. By December 1970, concrete in 138 bridges, including 58 in the experimental phase, had been emulsion cured. Between last December and May 1971, emulsion curing was specified for 25 more bridges let to contract.

William C. Zwick, Oklahoma bridge engineer, and R. S. Delamater, consulting engineer who has designed several of Wichita's bridges, emphasize they use emulsion curing under adverse as well as diverse conditions. "One of our problems in Oklahoma," Mr. Zwick said recently, "is our high temperatures and strong hot winds that complicate the curing process; this method helps to reduce that problem."

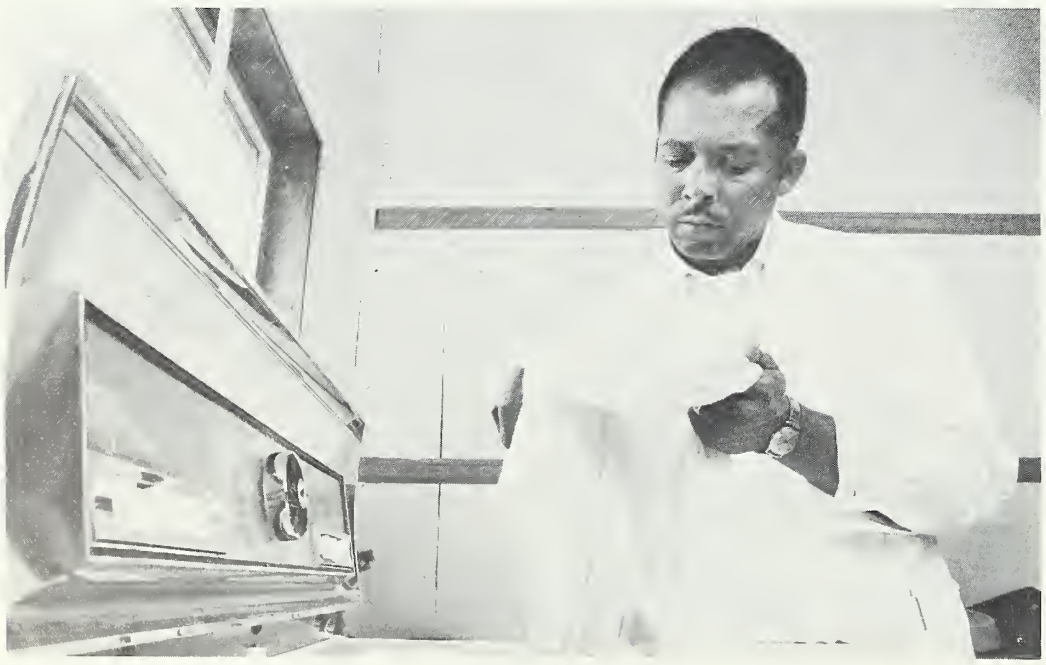
Mr. Delamater has emulsion-cured "small bridges and large ones under placing conditions all the way from freezing weather to hot and windy days." He first specified it on the Pawnee Avenue bridge.

"Because of a critical need to get the street reopened, the deck concrete was placed under winter conditions," Mr. Delamater said. "The work, accordingly, was done in somewhat of a rush—practically in a snowstorm—so wet curing would have been difficult. We were highly satisfied with the results from all angles." □

MOTH PROOFING. . . the search for safer pesticides

Surest test of a chemical claimed to be insect-proof is to expose the insects to it. Mr. Bry observes the reaction of insects to treated fabric (570A352–16).

In this machine, fabric that has been treated with a test chemical is exposed to intense light to determine how light affects the chemical after application (570A348–11).



Mr. Lang inspects treated fabric that underwent simulated home laundering. Treated cloth is washed or drycleaned with many types of cleaning compounds and then steam-pressed to determine how long the chemical remains in the fabric, and to see if detergents reduce the effectiveness of the treatments (570A324–3).

THREE experimental compounds offer promise as replacements for DDT and dieldrin as mothproofing agents.

Because of the chemical nature of the three experimental compounds, they are expected to be much less persistent than either DDT or dieldrin when the treating solutions are discarded.

During the past 6 years, several hundred compounds have been tested at the ARS Stored-Product Insects Research Laboratory, Savannah, Ga., by ARS entomologist Roy E. Bry, technician Joe H. Lang, and chemist Norman M. Dennis.

The first promising compound is a synthetic pyrethroid called SBP–1382, (5-benzyl-3-fury-1) methyl 2,2-dimethyl-3-(2 methylpropenyl) cyclopro-

panecarboxylate. Applied to woolen cloth from emulsion baths of 0.005, 0.01, 0.03, and 0.05 percent concentrations, it offered satisfactory protection against feeding damage by black carpet beetles and webbing clothes moth larvae. SBP-1382 was moderately resistant to removal by water, highly resistant to drycleaning, and effective for a least 6 months on stored cloth.

The second prospect, called C–9491 (0, 0-dimethyl 0-(2,5-dichloro-4-iodophenyl) phosphorothioate) is an organophosphate. It was applied to woolen cloth from emulsion baths of 0.05, 0.10, 0.15, and 0.20 percent concentrations.

Treated cloth was protected against black carpet beetle larval feeding before cleaning, after three drycleanings, and after 12 months of aging without cleaning. Protection became poor after two washings.

Both SBP–1382 and C–9491 appear promising for development as protectants for woolens that would be drycleaned rather than washed. Both compounds, however, may be usable as short-term protectants applied to washable woolens.

The third prospect, Gardona, 2-chloro-1(2,4,5-trichlorophenyl) vinyl dimethyl phosphate, is also an organophosphate and was applied to woolen cloth from both a solvent rinse and a laboratory padding machine similar to ones used by the textile industry to apply dyes and fabric finishes. Test results of these and earlier studies indicate promise as a home mothproofing treatment, as a mothproofer applied during drycleaning and as a treatment applied during textile finishing.

These three experimental mothproofers are still in the developmental stage and are neither registered nor recommended for use as mothproofers. Before a pesticide can be released, it must be registered by the Environmental Protection Agency which requires tests to assure that when used according to the directions, it will control the pest and not injure man or his environment. □

Fungi that kill WITCHWEED

DEAD and dying witchweeds, discovered in Carolina cornfields, have led to the isolation of fungi that may provide biological control of this pest.

Witchweed sucks the life from corn, sorghum, many grasses, and other crops by attaching itself to the roots of the host plant and depriving it of water and nutrients. This destructive foreign weed was first found in the United States in 1956, but ARS and the affected areas have cooperated in confining it to sections of North and South Carolina.

The discovery of the ailing weeds in the late 1960's prompted former ARS plant pathologist Charles W. Meister and Robert E. Eplee, supervisor of ARS' Witchweed Laboratory, Whiteville, N.C., to search for the disease agents.

They isolated five fungi from the dead witchweed leaves and from the soil of several infested areas. The samples were washed, sterilized, rinsed in sterile water, and dried on sterile filter paper. Pure cultures were obtained by growing the isolates from either a single spore or a hyphal tip.

Potted witchweed growing with host plants in a greenhouse was used for the pathogenicity trials. The scientists planted autoclaved corn seed in some pots containing witchweed residue infested with a single fungus. In others, the fungi were placed on moist soil next to emerging or flowering witchweed. Witchweed was also sprayed with the various fungi.

Four of the many fungi tested proved mildly virulent and killed witchweed under prolonged periods of high humidity. The other fungi were more potent.

Low quantities of the fungus *Sclerotium rolfsii* infected witchweed and attacked the base of the stem, causing the weed to topple over. It killed flowering witchweed, as well as younger plants, in a very short time. In fact, *S. rolfsii* killed every witchweed plant it penetrated, indicating more pathogenicity on witchweed than any other fungus examined.

The ARS scientists also found that witchweed seed is susceptible to fungus infection—*S. rolfsii* killed many seeds in culture.

These preliminary tests indicate that *S. rolfsii* has little effect on the germination and growth of corn seed and seedlings. However, the researchers caution that the use of *S. rolfsii* in the biological control of witchweed must be weighed against the possible destructive effect of introducing a fungus pathogen into the cornfields of North and South Carolina. □

Speeding soybean e

In a small laboratory in Illinois, a search of great dimensions is underway, a search for a soybean plant to push ahead the clock—the evolutionary clock, measuring time in millions of years.

Each week in the U.S. Regional Soybean Laboratory, Urbana, ARS plant physiologist William L. Ogren and plant biochemist Jack M. Widholm of the Illinois Agricultural Experiment Station screen 2,000 soybean plants.

Their search rests on discoveries that occurred between 1950 and 1966, when it became clear that plants could be divided into two photosynthetic groups. One group, photorespiratory (PR) plants, releases carbon dioxide (CO_2) into the air in its photosynthetic cycle; the other group, nonphotorespiratory (NPR) plants, does not.

Releasing or not releasing CO_2 is especially important to agriculture because all plants take in and use CO_2 to build cells and grow. Thus, NPR plants should grow faster than PR plants—and they do. But the only significant crops falling in the NPR group are sugarcane, corn, and sorghum, plants ranking high on the evolutionary ladder. The majority of crops upon which the world's food supply rests are, unfortunately, PR plants.

A theory explaining the apparently wasteful loss of CO_2 by PR plants as they compete with their highly efficient NPR neighbors has been proposed by an eminent botanist, Dr. Andrew Goldsworthy in England. He theorizes that hundreds of millions of years ago, shortly after life dawned on earth and when all living organisms were much simpler in form, photorespiration served a vital purpose. He then speculates that later—tens of millions of years ago—the earth's atmosphere became rich enough in CO_2 to block off photorespiration. However, the capacity of plants to photorespire remained and was passed down to all later generations.

Dr. Goldsworthy says there is good reason to believe that the rich CO_2 concentration in our air has been declining over a long period of time through incorporation into great deposits of coal, peat, and oil, as well as into today's vast populations of living organisms. He believes that the present reduction in CO_2 barely permits photorespiration to resume. However, the lower CO_2 level has not yet continued long enough for natural selection to have eliminated the wasteful process in most plants. And it must be eliminated for plant life—and animal life, in turn—to survive in the changing atmosphere of our earth.

Dr. Ogren and Dr. Widholm are trying to help nature produce the more evolutionarily advanced NPR plants.

By means of gamma rays or other mutagenic agents, they hope to create a mutant soybean with an altered enzyme that will turn off the photorespiratory process.

Dr. Milton Constantin of the Oak Ridge National Laboratory in Tennessee is supplying soybean seeds treated with gamma rays or thermal neutrons. These treated seeds are planted and grown at Urbana and their seeds harvested. The seedlings grown from the harvested seed then become the experimental plants to be screened.

The soybean plants, along with NPR corn plants, are planted in a growth chamber under fluorescent lights and allowed to grow under normal conditions for 10 days. After the 10-day period, an airtight canopy is lowered. The corn plants then begin to reduce the normal CO_2 level of the air in the growth chamber as they lock up CO_2 in growing. As the CO_2 level in the air lowers, the PR soybeans photorespire at an increasing rate, releasing more and more CO_2 into the air—even at their own expense—with the result that they yellow and die within 7 days. The corn plants remain green and thriving, thus providing a dramatic comparison of the two different photosynthetic pathways and the resulting survival ability of each group of plants.

Far left: During harvesting of soybeans in the growth chamber, the scientists look for that one possible exception to normal soybean photorespiration. Dr. Ogren holds a promising candidate (870A822–3). Left: In the search for various abnormalities caused by irradiating the seeds, scientists find a chlorophyll-deficient mutant (870A817–11).

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Should a single soybean plant survive the low CO_2 level during the course of testing, it will mean that the soybean, like the corn, released little or no CO_2. Then agriculture will have accomplished an amazing feat—for the first time a photorespiratory plant will have been changed into an efficient, fast-growing nonphotorespiratory plant. The estimated mathematical chances of such an occurrence are 1 in 100,000. So if the screening continues for 5 years as is planned, 500,000 soybeans will have been scrutinized. Hopefully and mathematically, five NPR soybeans should be found.

If the soybean search is successful, the program will be expanded to include other food plants. The ability to change our PR crops to NPR crops would make it possible to increase world food production by as much as 50 percent, using no more land than at present. This would push the evolutionary clock for PR crop plants perhaps millions of years ahead into the age of NPR plants, thus catapulting agriculture into an amazing efficient new era. □

Above: Soybeans and corn planted in a growth chamber. The corn plants reduce the CO_2 level, so that soybeans die because of photorespiration, usually within 7 days (870A817–19). Left: If a soybean plant survives, thus showing that it might have a reduced level of photorespiration, it is transplanted and a record kept. It will be grown to seed, and these seeds planted for further testing (870A821–34).

Dr. Devine holds two alfalfa plants with contrasting degrees of resistance to anthracnose (1270X1235–14).

A step closer to ANTHRACNOSE-RESISTANT ALFALFA

FOR THE FIRST TIME, plant breeders—public and private—will be able to use anthracnose-resistant alfalfa germplasm to produce resistant alfalfa varieties adapted to specific geographical areas.

Anthracnose attacks the stems and crowns of alfalfa plants in the East and Southwest. The disease thins stands, weakens overwintering capability, and reduces yields as well as the life of stands. In the eastern half of the United States alone, some 4 million acres of alfalfa are affected by anthracnose. Millions of dollars in potential yields are lost annually.

Five highly resistant and two moderately resistant populations were developed from varieties and experimental strains at Beltsville, Md., by ARS plant breeders Thomas E. Devine and Clarence H. Hanson. Though the percentage of highly resistant plants in the parent varieties ranged from 1 percent to a high of 5 percent, the percentage in the selected populations has been raised to 59 percent and 80 percent, respectively.

In their developmental work, the scientists combined rigidly controlled laboratory and greenhouse conditions, an effective breeding procedure and inoculation technique, and honeybees for pollination.

Dr. Devine and Dr. Hanson used recurrent phenotypic selection (a form of mass selection) to build up resistance rapidly and to preserve genetic variation for characters that were not selected. Preserving this genetic variation will increase the value of the germplasm to alfalfa breeders.

They screened a total of 140,000 plants in all cycles. About 200 resistant plants within each population were intercrossed in each cycle to initiate a new generation.

The dry inoculum technique, developed at Beltsville last year (AGR. RES., Aug. 1970, p. 6), enabled the scientists to inoculate large numbers of seedlings with the disease organism precisely, rapidly, and at a low cost. Also, many hours of hand labor were saved through the use of honeybees after each cycle to pollinate the plants selected for resistance.

Dr. Devine and Dr. Hanson say that the usefulness of these new populations for a specific environment could be increased by imposing field selection to isolate germplasm that is well adapted to that environment.

Seed of the final populations was sent to ARS agronomists Oliver J. Hunt and Richard N. Peaden at Reno, Nev., for increase. Then this seed was sent to the Beltsville scientists who distributed the material to interested plant breeders. □

For Puerto Rico

MORE PROFIT FROM PASTURES

PROFIT OR LOSS to Puerto Rican dairy farmers may depend upon their ability to cut down on the use of high-cost imported concentrate feeds, which amounts to about $15 million worth (180,000 tons) yearly.

Such cuts can be made, say ARS researchers on the island, by making better use of well managed, heavily fertilized pastures.

Studies over the past 2 years have shown that concentrates, now almost universally fed in Puerto Rico at the rate of 1 pound of 20-percent concentrate per quart of milk produced, can be sharply reduced by using these well-fertilized pastures. On good pastures, little or no concentrate feed should be required for the first 11 quarts of milk.

Further, many of the dairy farms are in the Coastal Region on expensive, level or rolling lands suitable for mechanized crop production. Some 500,000 acres of land, however, are available in the humid Mountain Region for dairying. These acres are too steep—up to 60 percent slopes—for mechanized farming and need the unique protection against erosion provided by a cover of grass.

Mountain pastures would be a means of releasing some of the coastal lands for mechanized crop production while getting maximum use out of steep slopes.

Pastures on steep slopes in a feeding system under study by ARS can replace up to two thirds of the concentrates in current dairy ration without reducing milk yields, butterfat content, or body weight throughout the lactation period.

To test the feeding system in a commerical operation, ARS agronomist Ruben Caro-Costas, in cooperation with the Puerto Rico Agricultural Experiment Station, divided 48 Holstein cows from a commercial herd of 150 cows into four groups of 12 cows each, put them on pastures grazing along with the rest of the herd, and evaluated the following feeding systems: One pound of 20-percent protein concentrate per quart of milk produced; 1 pound for every 2 quarts; 1 for every 3 quarts; and 1 for every 4 quarts.

Results of a full lactation period of the 48 cows grazing freely on intensively-managed pastures showed that the cows produced the same quantity of milk when fed 1:1, 1: 2, and 1: 3 rations. The cows produced an average of 17 quarts daily as compared to the island-wide average of 9.9 quarts. Last year's average for the whole herd was 17.3 quarts.

Reducing concentrate feeding to the 1: 3 ration can sharply increase the profit farmers receive from their dairy herds. For example, in a 100-cow dairy herd producing 15 quarts daily per cow, the bill for concentrates could be reduced by about $18,000 yearly. After deducting about $5,000 for the additional costs of fertilizing, fencing, and managing pastures intensively, the annual increase in profit to such a farmer would be $13,000.

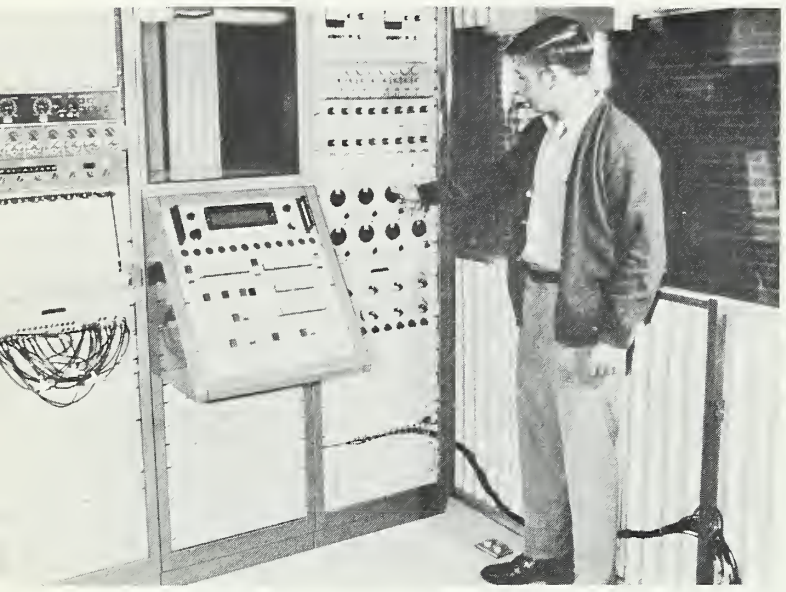
Mr. Caro-Costas and ARS soil scientist José Vincente-Chandler are strongly recommending the reduced use of concentrates by dairymen. Several dairy farms are adopting these practices.

This system maximizes use of pastures, a product of Puerto Rico's most important natural resources: rainfall and year-round growing weather. It also can sharply decrease the dollar drain on the island's economy. □

Holstein dairy cows graze steep, highly fertilized pastures in the humid uplands of Puerto Rico (PN–1971).

Dr. Taylor checks sensors before testing an experimental tire on Houston clay sod (PN–1972).

Electronics technician Jack Jarrell demonstrates the highly sophisticated instrumentation in the trailer towed behind the test car (BN–83121).



TRACTOR TIRES/ lug angles don't affect traction

THE LUG ANGLE on tractor tires does not significantly affect traction—whether the angle is less than 90 degrees as in conventional tires or up to 140 degrees.

Tire manufacturers have varied lug height, spacing, angle, and shape, as well as tread width and curvature, in seeking improved performance from their tractor tires. While a low lug angle has been thought to produce superior traction, this belief was not substantiated in research at the National Tillage Machinery Laboratory, Auburn, Ala., by ARS agricultural engineer James H. Taylor.

Results were inconclusive when the effect of lug angle on traction was tested in the laboratory in 1949–50, but instrumentation was less sophisticated than that now in use. Dr. Taylor repeated the earlier studies, using the same set of experimental tires, which are identical in construction except for lug angles of 40, 50, 70, and 80 degrees. Dr. Taylor also reversed the wheel mountings, with the tread of the same tires run backward, to test lug angles of 140, 130, 110, and 100 degrees, respectively.

A similarly constructed smooth tire was included in the tests to verify that soil conditions were such that lugs would give greater traction than no lugs—which they did in all tests.

Tests were conducted in 250-foot-long soil bins containing six standard soil types—Lakeland loamy sand, Decatur silt loam, Norfolk sandy loam, Decatur clay loam, Vaiden silty clay, and Houston clay sod. The scientists did not conduct tests with lug angles above 90 degrees in the latter two soils.

Continuous measurements were made of drawbar pull, torque, velocity, angular rotation, and weight transfer. Travel reduction (slippage) was calculated continuously by an analog computer.

Using two statistical comparisons of traction—dynamic traction ratio and tractive efficiency—Dr. Taylor found little difference in performance with the eight lug angles tested. He concluded that customarily used lug angles below 90 degrees are probably no more effective than angles above 90 degrees.

Dr. Taylor noted that lug angle may affect rate of tread wear or the ride of tires, especially on hard surfaces. And he pointed out that some combination of lug angle and lug spacing or other variable not included in his research may improve traction. □

Improving the chip potato

POTATOES that can be made into chips immediately after cold storage may be commercially available to growers within the next decade.

At present, cold-stored potatoes make a dark, unappetizing chip unless kept at room temperature for 2 to 4 weeks before processing. This reconditioning period can spoil the potatoes, especially if they were diseased, mechanically injured, or frost-damaged.

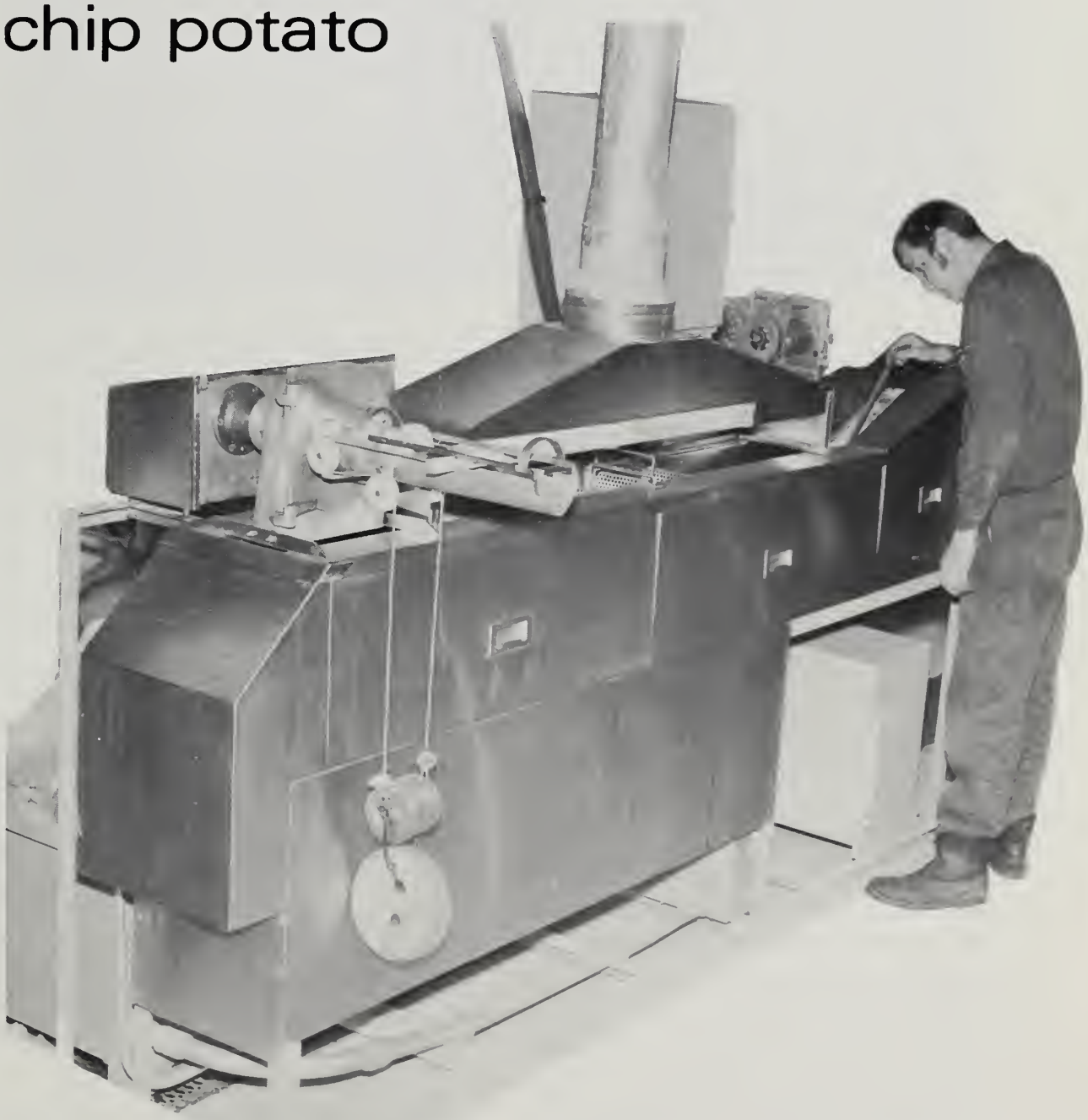
For the past 7 years, plant breeders at the University of Minnesota under Dr. Florian I. Lauer have been cooperating with ARS scientists to develop a potato with the desired processing characteristics. Their starting point for this objective was a plant from a cross of a South American introduction with a commercial variety, Katahdin. But this plant proved to be low-yielding, so its progeny was crossed with other plants that yield well in this climate.

This year, 40 percent of 2,600 seedlings from these experimental plantings passed the chipping test directly from cold storage. In spite of this encouraging breakthrough, the researchers estimate that another 10 years may be required to develop a commercially acceptable variety.

Tubers are grown from the experimental seedlings, put into cold storage, and then made into chips at ARS' Red River Valley Potato Processing Laboratory, East Grand Forks, Minn. The work is facilitated by a new standard chip cooker developed there by the laboratory head, food technologist Roy Shaw. This cooker duplicates commercial frying conditions, but it can be used to chip as little as half a tuber, permitting the other half to be retained and planted to continue that selection if the results warrant. Since the typical first-year seedling will yield only 3 to 10 tubers, such small-scale processing facilities are essential.

The new cooker has proven to be far more efficient than previously used pilot-plant equipment and it enables one technician to chip from 110 to 120 samples a day. Before, two men used to be needed to chip 30 to 40 samples a day.

This work should shed additional light on the mechanism responsible for chip darkening. It might show that potatoes that can be chipped directly from cold storage are low in an enzyme called invertase, which at low temperatures converts sucrose to fructose and glucose, sugars known to be responsible for chip darkening (AGR. RES., Oct. 1966, p. 7). Or perhaps the enzyme in these potatoes is controlled by a quicker or more abundant production than usual of an invertase inhibitor which normally forms in potatoes after the first few weeks of cold storage. □



Technician Gary Nelson observes chips as they come out of the vat. At left is the pulley that adds weight to help feed potatoes into the slicer (PN–1973).

Treated cattle are held in "artificial streams" at Beltsville, Md., to study the fish kill potential of pesticide shed by animals in streams (671K696–11).

On guard against pollution

IN NORTHERN NEVADA last spring, fingerling trout were killed when cattle still wet from a dip for scabies mites splashed through a creek, sending some of the lethal mixture downstream.

ARS scientists at Beltsville, Md., are simulating the conditions that resulted in the fish kill to determine how to prevent this problem in the future. Preliminary results indicate that cattle will have to be withheld from streams and ponds for a longer time than has been the practice previously.

This study is but one of the actions ARS has taken in line with President Nixon's directive asking Government agencies "to provide leadership in protecting and enhancing the quality of the Nation's environment. . . ." Added to functions already set up to cover the major areas of its concern—pesticides, disinfectants, and animal wastes—ARS has organized an Environmental Quality Task Force to reevaluate ARS procedures and policies. ARS has also appointed regulatory veterinarians as Environmental Quality Officers (EQOs) in each State and has begun surveys of waste disposal systems in stockyards, markets, feedlots, and at its own field stations.

On EQOs fell the duty of investigating the fish kill, since they are responsible for monitoring the use and disposal of pesticides, disinfectants and their containers. For this duty, training conferences are held periodically, and the EQOs, in turn, instruct station personnel, farmers, stockmen, and the general public.

In surveying waste disposal systems, EQOs are looking at methods ARS field stations use to dispose of dead diseased animals in disease eradication programs. The hog cholera eradication program in the Dismal Swamp area of Virginia and North Carolina is a case in point. The ARS supervisory task force found that burying swine carcasses on some premises was unsatisfactory. Because most of the land in the eradication area was reclaimed swampland with the water level too close to the surface for sanitary disposal, the dead carcasses were taken to rendering plants.

Also under review is the disposition of human waste and spent media at the Mission, Tex., screwworm and scrapie facility. Because the sewage treatment plant, constructed during World War II, cannot handle the 80,000 to 150,000 gallons of sewage treated each week, some of the effluent is not fully processed when it is discharged on the soil of the station. Two experimental treatment lagoons have been constructed in an attempt to solve this problem.

In addition, ARS control and eradication programs for brucellosis, tuberculosis, and poultry diseases now require that all disinfection practices be conducted under regulatory supervision to prevent possible pollution of the environment.

Antipollutant procedures at ports-of-entry and quarantine stations are also receiving close attention. Animals for export must be transported in new or freshly disinfected crates. At the Clifton, N.J., quarantine station, all wastes such as manure, hay, and straw are either burned or placed in controlled compost piles for future use in fields. Insecticides from the dipping vat are pumped into a cesspool.

At Canada-United States ports-of-entry, wastes are piled up, sprayed with disinfectant, and spread on nearby fields. At United States-Mexico port-of-entry, experts of USDA's Soil Conservation Service are assisting ARS in locating safe areas to dispose of the pesticides used to dip the more than one-half million animals imported from Mexico annually.

In carrying out task force recommendations, ARS officials coordinate their efforts with other Federal and State agencies, land-grant colleges and universities, educational and social institutions, private organizations, and the public. □

Dry-peeling adapted for fruit

Fruit can now be "dry-peeled" in a process that reduces by 70 to 80 percent the amount of wastes entering a plant's waste stream.

The fruit process was adapted from one that ARS developed earlier for the dry-peeling of potatoes. The potato process is now being installed in commercial plants.

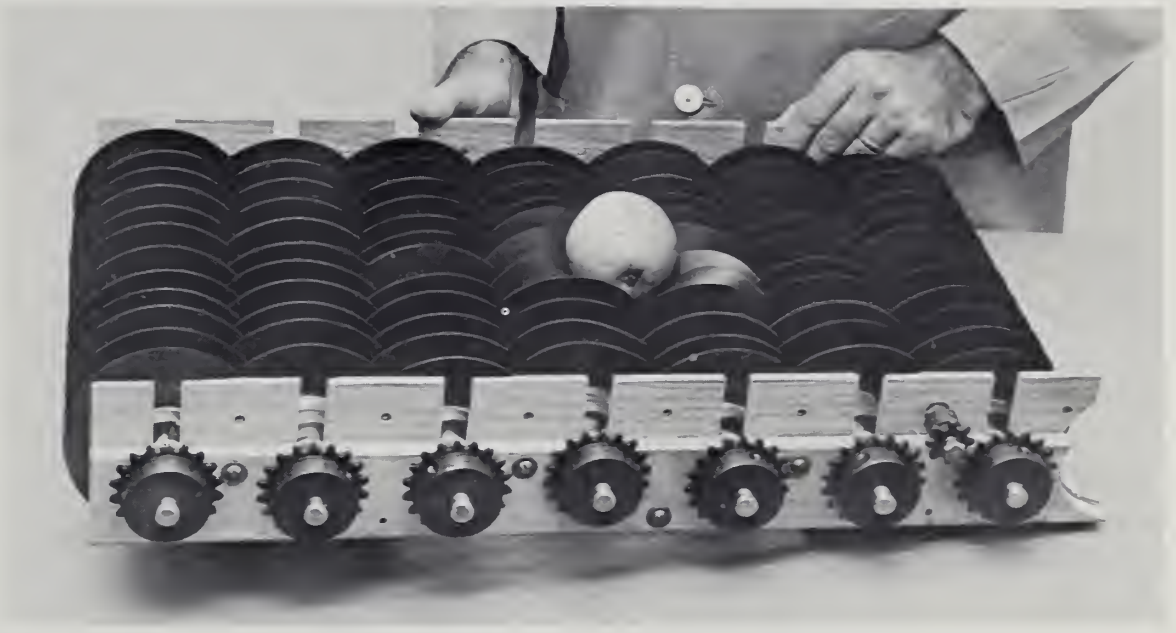
Conventionally, most commercial plants soften or loosen the peel with a hot lye solution, then remove it with water sprays. The waste goes into the plant's effluent stream. With the new processes, however, the tubers or fruit are briefly soaked in the hot lye, then the peels are removed by dry rubbing.

In fruit-peeling runs made in commercial plants on cling peaches, apricots, and pears, 70 to 80 percent of the peel was removed by the experimental method; the balance was removed in the final water rinsing.

Briefly, this is how the process works: The lye-treated fruit is dropped into a trough in which row upon row of rubber disks line the bottom. Spacing between the disks in a row and between rows varies, depending on the size of fruit being peeled. Below the disks is a trough with a solid bottom. As the rows of disks spin, they move the fruit and at the same time remove the peel, which is spun off as the disks revolve and collects in the bottom of the trough. The peel waste can be kept separate from waste water for disposal as a semisolid.

The rubbing action is very gentle to avoid damaging the tender flesh. Peeling loss—the amount of edible flesh removed with the peel—is about the same with the experimental method as with present commercial methods.

The initial research equipment design was conducted at the ARS Western regional research laboratory, Berkeley, Calif. Subsequent testing was in cooperation with the National Canners Association and the Federal Water Quality Administration.



These flexible rubber disks take the place of water sprays for removing the peel from certain fruits while reducing the amount of effluent (PN–1974).

Chemical aids deerskin stitchers

Deerskins tanned with glutaraldehyde are easier to penetrate with a sewing needle than skins tanned in the conventional manner with basic chromium sulfate. Chrome-tanned leather is rather difficult to machine-sew and causes the needle to dull more quickly than is desirable.

ARS chemist Muriel L. Happich of the Eastern marketing and nutrition research laboratory, Philadelphia, Pa., found that glutaraldehyde in the tannage produced leather with fibers that separated more easily than in chrome-tanned leather. Thus, needle friction was reduced. Mrs. Happich's research was a contribution to a Rural Areas Development project to form a sewing center on a Montana Indian reservation where deer, horse, and cattle skins would be used to make leather products.

Matched sides of deerskins served as the test material. Two skins were slit down the center and three of these sides were tanned with basic chromium sulfate. One of the three sides was retanned with glutaraldehyde. The fourth side was tanned with 15-percent glutaraldehyde. The matched sides were finished into glove leather at a commercial tannery and needle penetration tests were conducted in the laboratory. Actual production of the leather products should reveal the correlation between laboratory tests and commercial sewing.

Glutaraldehyde tanning was developed by scientists at the Eastern laboratory (AGR. RES. Nov. 1959, p. 12). Deerskins tanned with this chemical dyed uniformly, and they were soft, with improved perspiration resistance. Their strength compared favorably with that of commercially tanned deerskin leather.

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Fruit sounds off

Ever thump a watermelon to judge its ripeness? This old practice may well have been the forerunner of recently developed sonic techniques to determine internal quality of fruit.

Present methods for evaluating a fruit's internal quality often damage the fruit by bruising or puncturing the skin. By measuring the response of a fruit to sonic vibrations, ARS agricultural engineer Essex E. Finney, Jr., of Beltsville, Md., has been able to evaluate for firmness, juiciness, and overall eating quality without damage. Although he worked with Red Delicious apples, peaches, and bananas, the results should apply to other fruits as well.

Fruit is placed on a vibration exciter capable of generating 20 to 10,000 vibrations per second. Vibrations transmitted through the fruit from its lower surface are recorded and measured at its upper surface. Each fruit has its own characteristic response curve, and a natural resonance that is readily identified and easily reproduced for any given fruit.

A fruit's natural resonance varies according to its size and texture. To compensate for this variance, an index of firmness factor (f^2m) is used. This factor is based on the natural resonance or frequency of the fruit (f), and its mass or weight (m). It is directly influenced by changes in the fruit's elastic properties, and is correlated with fruit texture.

Tests with apples show that firm, juicy fruit tends to have high f^2m readings, while soft, low-quality fruit tends to show low f^2m values. There were significant but low correlations between eating quality determined by a taste panel and f^2m factors.

This sonic technique offers future prospects for objective, nondestructive evaluations of fruit quality. More research is necessary, however, to determine precisely what resonance characteristics indicate desirable fruit quality and to adapt this technique for commercial use.

Bee Stock Center opens

A new ARS Bee Stock Center has been dedicated at Baton Rouge, La. The only facility of its type in the world, the new Center has some 400 hives housing at least 16 million bees of 20 breeding lines.

The Center furnishes stock to 25 entomologists at six other ARS apiculture laboratories, plus other scientists in the United States and abroad.

At the Center, entomologists William C. Roberts and John Harbo and technician Gary J. Reynolds, in cooperation with the Louisiana Agricultural Experiment Station, are studying techniques that would permit scientists and commercial bee breeders to maintain a larger variety of genetic stock with less labor and lower costs than are now incurred. Such stocks are important in breeding bees for pollination and honey production, disease resistance, and manageable temperament. The Center also maintains bees of uniform genetic backgrounds for use in bee research to reduce variability in test results.

Correction: Sunflowers

Our June issue carried an article entitled "Sunflowers: Next wonder crop?" which stated that Russian sunflower oil production was over a billion tons of oil a year. The correct figure is 2 million tons.

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